NEW ZEALAND AGRICULTURAL ENGINEERING INSTITUTE

LINCOLN COLLEGE CANTERBURY NEW ZEALAND

FODDER BEET CROPPING USING MECHANISED METHODS

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FODDER BEET CROPPING USING MECHANISED METHODS

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LINCOLN COLLEGE CANTERBURY NEW ZEALAND

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INTRODUCTION

Fodder beet yields a high-energy low-fibre stock food which is attractive to dairy and beef cattle, sheep and pigs.

It produces a higher yield of feed units per acre than any other farm crop.

It is resistant to most pests and diseases.

It is more drought resistant than most crops.

The crop may be fed for eight months of the year or more, without drying, housing or processing.

But because of the many hours of laborious hand work needed to thin and weed this crop the acreage under fodder beet has remained very small.

This bulletin outlines a method of sowing, cultivating and harvesting fodder beet which, if followed, will allow the farmer to benefit from the excellence of the crop as a stock food while eliminating the labour of hand weeding and thinning.

In raising the crop the problem of hand work is overcome by -

Using the correct seed
Sowing with a precision spacing drill
Providing the right seed-bed conditions
Controlling weeds in the row with selective weed killers
Controlling weeds between the row by mechanical means

THE SEED

Beet 'seed' as it occurs naturally is a cluster of several seeds in a corky husk. If sown in this form several seedlings will often result from each cluster and these will be inter-twined so that individual root development is hindered.

By a process known as 'rubbing' the singleness of natural seed can be increased. From every 100 rubbed seeds which germinate perhaps 60 will produce single plants. Some of the others will give two seedlings, a very few may give three.

The seed must be graded after rubbing to remove small pieces of husk and undersize particles and also any large seeds which have not been rubbed sufficiently. In this way, a uniform sized seed is produced without affecting the germination greatly. The normal commercial size grading is 7/64 to 11/64 in. Gradings of 8/64 to 10/64 in.or 9/64 to 12/64 in. may also be obtainable.

Most cereals, and the seeds of other crops are treated now with a fungicide to help fight off soil fungi. Fungi can, and often do, cause the death of small seedlings even before they emerge from the soil. Beet seeds have given up to 20% better germination when treated in this way.

No seed with a poor germination should be considered. All seed suppliers are legally obliged to provide a certificate of germination if requested to do so.

SEED BED PREPARATION

Fodder beet can follow any crop in the rotation but all trace of previous crop residue should be well buried in the initial ploughing. If the crop is to follow grass this should be surface worked (discs) before ploughing to prevent regrowth between the furrows.

N.B. Beet will not establish or succeed in acid soils. All paddocks for beet should be soil tested (Dept. of Agriculture 'quick test'). The minimum soil pH is 5.8 (unless on a peat soil) but a pH of 6.0 to 6.4 is better. Apply an adequate dressing of lime if below 5.8. The amount will depend on the soil type - your local advisory officer should be able to help. The lime should be worked into the soil before ploughing.

Ploughing

Ploughing may be done in lands or round and round, but it should be done as well as possible and care taken to avoid deep finishes and high ridges. On all except the lighter soils, it is advisable to complete ploughing by early winter. This allows the furrow slice to settle under its own weight (do not roll) and the top soil to become well weathered over winter.

Fertiliser

For beet, fertiliser is applied as an overall dressing immediately before final seed bed preparation. Phosphate is essential. Nitrogen may be, too, if the previous crop was removed from the paddock, but it could be omitted following the ploughing of a well stocked grass paddock. The requirement of potash, if any, should be determined from the initial soil analysis. A dressing of 5 or 6 cwt. of No.2 potato manure, now known as potato fertiliser (NPK 4-5-10), has been generally recommended during the 1967/68 trials in Canterbury. Extra nitrogen if required can always be applied as a top dressing at a later date.

It is unwise to skimp the fertiliser with beet as the yield will normally repay extra feeding.

Final Cultivation

After applying fertiliser to the weathered furrow slice subsequent cultivations should be limited to straight tine working to a depth of no more than 4 inches. This will keep the weathered soil on the surface and at the same time conserve moisture. Many weed seeds in this layer will have rotted during repeated wetting and drying, and changes of temperature through the winter. Grubbers, cultivators and discs should not be used as they will only bring up raw, cold, unweathered soil with a fresh complement of weed seeds. (Weeds will not germinate from depths below 2 to 3 inches).

A 'dutch' harrow which combines the operations of clod crushing, levelling and harrowing has been constructed by the N.Z.A.E.I. and this has proved ideal in forming the required seed bed. Similar implements are widely used in U.K. and Europe, for sugar beet and other crops. Two or three strokes with this implement have been sufficient to produce a firm, fine, level seed bed on a weathered furrow slice.

Seed should be sown immediately after final working; the same day if possible. Any delay allows weeds to germinate and gain a lead over the beet seedlings.

SOWING

Time of drilling

As fodder beet is a biennial it does not normally reach maturity in its first season of growth. Provided conditions are suitable for growth, it will continue to grow and its yield will be dependent on the length of the growing season, other things being in adequate supply. It is wise, therefore, to sow early. Mid-September is not too soon unless in an area with many late frosts. The crop is not frost tender, but some beet, when subject to prolonged periods at low temperatures in their early stages of growth, may produce a flowering stem and run to seed ('bolt') in the first season.

Precision spacing drills

Most ordinary drills feed seed through a variable aperture by one means or another so that the seed is trickled in a steady controlled stream into the coulter furrow. No attempt is made to regularise the spacing between seeds.

With the spacing drill, the metering mechanism is capable of selecting individual seeds and placing them into the soil at a specified distance apart. Units are carried at ground level so that the regularity of feed is not interrupted by the seeds having to fall down lengthy coulter tubes to subsequently bounce or roll out of position when striking the soil.

The grading of the seed being sown must be known so that the correct cell size in the metering mechanism can be selected. For 7 to 11/64 in. seed a cell size of 13 to 15/64 in., depending on the drill, is used.

Two makes of spacing drill are currently available in New Zealand, the Stanhay* and the Webb**. The Stanhay employs a reinforced rubber belt in which the cell holes are punched, while the Webb uses an aluminium wheel with the cells machined in its circumference. Seed spacing may be altered by changing the belts or cell wheels and/or, in some models by changing simple gearing by lever or V-belt on the drill driving mechanism.

Row width and seed spacing

The cropped area must be completely covered with foliage as early in the season as possible for two reasons -

1. To trap the maximum amount of energy from the sun. Energy is potential yield.

2. To provide an effective weed smothering canopy.

Wide rows or gaps between plants allow the sun's energy to fall wastefully onto bare soil and also encourage weeds to grow unhindered.

The N.Z.A.E.I. has used 20 inch wide rows with good results. Seed with a 68% laboratory germination was sown at a 5 inch spacing within the row in the 1967/68 trials (2 lb seed per acre), although this could possibly have been increased to a 7 inch spacing with benefit. Tractor tyres 12 inches wide caused no difficulties although some crop damage might occur if wider tyres were used.

Depth of sowing

Seed should always be placed into moist soil. A depth of $\frac{3}{4}$ inch is normally adequate although this may be increased to a maximum of $1\frac{1}{4}$ inch if conditions are dry. The shallow seed bed technique already described should ensure ample sub-surface moisture for immediate germination.

All coulters should be checked for uniformity of depth.

Speed of travel when sowing

The recommended speed should not be exceeded or each metering cell will not carry its full complement of seeds and the crop will be gappy.

* Howard Rotavator Co. Ltd., P.O. Box 30-233, Wellington.

** C.H. Campbell Ltd., P.O. Box 21, Marton.

WEED CONTROL

Weed control within the row

Selective herbicides can now control annual weeds within the beet crop without affecting the crop plants. However, they will not control established perennial weeds such as docks, Californian thistles or cough grass.

Only PYRAMIN is commercially available in New Zealand at present, although others are coming into use overseas and are being tried experimentally here.

PYRAMIN may be applied (a) pre-emergence, i.e. simultaneously with the drilling operation or as a separate operation as soon as possible after, or (b) post emergence, i.e. after the seedlings have emerged. The seedlings may be sensitive to PYRAMIN immediately after emergence so should not be sprayed post-emergence until their cotyledon leaves are fully developed.

Weed seedlings should not have grown beyond their first pair of true leaves at the time of spraying or they may be resistant. If there is any danger of the weeds growing through the susceptible stage before the beet seedlings are at the full cotyledon stage, it is probably better to spray for the weeds and risk some beet damage, than let the weeds grow on and not be able to control them.

Rate of application

Normally recommended rates of application for PYRAMIN are 5 lb/acre as a pre-emergent herbicide and 6 lb/acre as a post-emergent. For the post-emergent application a non-ionic wetting agent e.g. CITOWETT, at 1 pint/acre must be added or control will be ineffective.

Band spraying

The above rates are what would be used as an overall application. However, it is more usual for the application to be confined to a narrow band over the drilled row only. The N.Z.A.E.I. has used a 5 inch band width in its 20 inch wide rows so that in fact only a quarter of the total cropped area is sprayed. This technique reduces the amount of material required per cropped acre to only $1\frac{1}{4}$ lb for a pre-emergent application and to $1\frac{1}{2}$ lb plus $\frac{1}{4}$ pint (5 fluid ozs) of CITOWETT for post-emergence use. As PYRAMIN costs approximately $4 per pound this effects a considerable saving. Sprayer refilling times are also reduced as less water is required.

If a 7 inch band width were selected to allow a greater latitude in steering, the rate in 20 inch rows would obviously be a third of the overall sprayed rate instead of a quarter.

The N.Z.A.E.I. boom for band spraying was made from a length of 1 inch water piping long enough to cover five 20 inch rows. Holes were drilled and tapped to take nozzle bodies at 20 inch spacings and a short length of $\frac{1}{4}$ inch pipe was brazed in for the feed hose. Spraying Systems T-jet nozzles No. 730231 (or Monarch 39F) at this spacing apply 13 gallons per acre at 3 m.p.h. and 20 psi. One and a half pounds of PYRAMIN and 5 fluid ounces ($\frac{1}{4}$ pint) of CITOWETT should therefore be added to 13 gallons of water for each acre of crop.

The boom is carried on brackets on the front axle of the tractor and band width is altered by adjusting its height above the soil surface. Band width should not be set with the tractor standing on a hard surface as wheel sinkage in the paddock will cause a reduction in band width and a consequent increase in concentration on the sprayed area. Check band width from time to time during work.

Effectiveness

Unless the surface of a soil is moist at the time of pre-emergence application of PYRAMIN the material will only become effective following about $\frac{1}{3}$ inch (30 points) of rain or the equivalent in irrigation. The active ingredient must be washed into the soil to the depth of the germinating weed seeds or it has little or no effect on them. In Canterbury and other areas where rainfall is infrequent and unpredictable, post-emergence applications are likely to be more reliable. These do not need rain. Do not forget to add the wetting agent for post-emergence application.

The effective life of PYRAMIN in the soil appears to be 4 weeks or perhaps a little longer. As beet seedlings are incapable of very rapid growth in their early stages of development, it will usually be necessary to give another application to control the second emergence of weed seedlings.

As with all herbicide spraying, it is most important that the spraying tractor be fitted with an accurate speedometer, and the spraying gear must be in good order. Nozzles should be replaced if worn, and their filters kept clean. The pressure gauge should indicate correctly.

PYRAMIN is a wettable powder and so requires good agitation to keep it in suspension while spraying. Before adding it to the spray tank the required amount should be mixed with a small amount of water in a separate container. It can then be poured easily. Any mixture remaining at the end of a day's spraying should be run into a container which can be thoroughly stirred and agitated before use.

NOTE: Fodder beet is not a member of the Brassica family. Herbicides which are used on swedes, turnips, chou mollier and kale must not be used on fodder beet.

Weed control between the rows

Weeds growing between the rows can be controlled more cheaply by mechanical means than by using a selective herbicide. Tractor hoes are not common in New Zealand, but as farming becomes more intensive their use is likely to increase.

Front or mid-mounted hoes are operated solely by the tractor operator but they are usually designed with special mountings for specific makes of tractor. Rear mounted hoes will fit any tractor with a hydraulic lift, but require a steersman in addition to the tractor operator. Two makes of English tractor hoe, the Nicholson* and the Webb**, are available through the New Zealand agents.

For the first hoeing, when seedlings are small, concave discs are usually fitted to the hoe stems to prevent smothering. The ground is usually cut to within $1\frac{1}{4}$" or $1\frac{1}{2}$" on each side of the plants. Discs are removed and a wider setting is used for any subsequent hoeing. The depth of working should not exceed $\frac{1}{2}$ to $\frac{3}{4}$ inch, otherwise weeds will be undercut and may re-root again. An old saying that hoeing should be done when there aren't any weeds is a useful guide. If hoeing is done in the cotyledon stage weeds will never present any problems to the hoeman or the crop.

Stale seed bed technique

Where a heavy infestation of weeds is to be expected the stale seed bed technique may prove useful.

The seed bed is prepared as described - firm and level with a fine tilth, but drilling is delayed until the ground is covered with weed seedlings, a delay of perhaps 3 to 5 weeks. Without further cultivation the crop is drilled into the weedy soil with as little soil disturbance as possible. Before any beet seedlings have emerged (4 to 7 days depending on the time of the year), the crop is sprayed overall with GRAMMOXONE (paraquat), if any grassy weeds, or REGLONE (diquat), if only broad leaved weeds, at 2 pints per acre in 20 gallons water + 1 pint of wetting agent. The beet seedlings will emerge into a perfectly clean undisturbed seed bed and it will be some days before any more weeds begin to appear. The normal post-emergence application can be applied when required. The beet seedlings will be well ahead of any weed competitors by then.

NOTE: There is an element of risk with this procedure. If, for any reason, the GRAMMOXONE or REGLONE cannot be applied before the beet emerge the weeds will have a considerable lead over the beet and trouble can be expected.

* Howard Rotavator Co. Ltd, P.O. Box 30-233, Wellington.

** C.H. Campbell Ltd, P.O. Box 21, Marton.

PESTS AND DISEASES

These are very few, but the grower should be aware of them and know the appropriate measures where necessary.

Springtails

Springtails can attack and disappear before their presence is realised leaving the grower wondering why his crop does not come up. They are only a danger to the crop in the early cotyledon stage of growth.

Indications of their presence are punctured leaf surfaces and/or nibbled leaves. If in large numbers they rapidly consume the seedlings so that only the short stump-like stems may be visible just above the soil surface. If the growing point is eaten the seedlings will die. Providing protection can be given at this early stage of growth springtails may be ignored subsequently.

Control is both cheap and effective. An overall spray with GUSATHION 'A' at 4 oz/acre in 15 gallons water or GESAPON 80 at 4 to 5 oz/acre in 10-15 gallons water should be given just before or as the seedlings emerge. This confers protection until the seedlings are big enough to resist further attack. The N.Z.A.E.I. has obtained good control in 1967 by banding the application and using only 1 oz. of material per acre. To save an extra operation this can be done simultaneously when drilling by mounting spray nozzles on the drill units.

Alternatively, where the stale seed bed technique is being practised, the insecticide may be mixed with the dessicant provided it is used immediately after mixing.

Aphids

Aphids do little physical damage to beet unless present in very high numbers, but they can transmit virus to the crop and between plants in the crop. They are not normally a problem, but if control is required, the systematic aphicides METASYSTOX or ROGOR are effective. Application may be as an overall application or by banding over the rows of plants.

Cut worms

Cut worms live just beneath the soil surface and are the caterpillar stage of a night flying moth. They emerge at night and nibble round the developing bulbs at ground level when the plants are from 4 to 8 inches high. Damaged plants may be broken off from their roots by a fresh wind.

The number of plants attacked is usually small and the pest is not normally of economic importance.

Leaf miner

This grub of a dipterous fly often bores minute tunnels through the tissue between the upper and lower surfaces of the older leaves so that they may take on a greyish appearance.

Despite this extensive tunnelling the grubs have no effect on yield and control measures are unnecessary.

NOTE: Successive crops of beet can be grown on the same ground for two or more years, but this practice is likely to encourage the increase of any pest or disease organism which may be present.

HARVEST

Harvesting may begin before the crop is fully mature but care must be taken in introducing fodder beet into the ration of all classes of stock to avoid digestive upset. Actively growing fodder beet contains oxalic acid and certain nitrites which can prove harmful if fed to stock unaccustomed to them, or if fed in excess. On maturity, these materials break down and there is no risk at all in feeding.

The roots consist largely of carbo-hydrates but foliage has worthwhile protein content. Most farmers prefer to harvest and feed the beet with the tops on.

Where drainage is a problem beet may be difficult to remove from the paddock at times during the winter. Some beet should then be harvested and stockpiled when conditions allow and drawn from as required.

Direct feeding in situ is possible for pigs, sheep and cattle.

Mechanical harvesting

At present mechanical harvesters are not commercially available in New Zealand. Usually the beet are pulled by hand and loaded into trucks or trailers, but this method is laborious. Mechanical harvesting, however, is possible. A one man machine for both harvesting and feeding out is being developed by the N.Z.A.E.I. and a Danish machine has been imported for trials.

VARIETIES

The variety of beet chosen has a considerable bearing on the ease of harvesting. Fodder beet are a cross between sugar beet and mangolds. This cross has been developed in different forms and extreme mangold and extreme sugar beet types are available.

Sugar beet types have a very high dry matter content, but as their roots grow mainly below the ground they are difficult to dig and clean. Mangold types, on the other hand, grow almost on the top of the ground.

The varieties Yellow Daeno and Korsroe are the most widely grown. These have a dry matter content of about 15-16% and about two thirds of the root grows above ground. This makes them easy to pull and they require little or no cleaning.

MANGOLDS AND SILVER BEET

Although mangolds have a lower dry matter content then fodder beet they may be preferred by some growers. Exactly the same techniques and herbicides may be used with mangolds as for beet. Results in trials by the N.Z.A.E.I. have been equally good.

Of less importance, but as a matter of interest, silver beet has also been grown successfully this way by the N.Z.A.E.I. It is of the same botanical family as fodder beet and mangolds.

LIST OF N.Z.A.E.I. PUBLICATIONS UP TO OCTOBER 1968

Extension Bulletins (Free on request)

E/1 New Zealand Agricultural Engineering Institute - Purpose and Functions

E/2 Some facts about Tractor Safety Frames

E/3 N.Z.A.E.I. - What it is and what it does.

E/4 Fodder Beet Cropping using Mechanised Methods

Test Reports (10 cents each)

T/1 Bonser Safety Frame for David Brown Tractors 850, 880, 900, 950, 990.

T/2 Safe 'T' safety frame for Fordson Major Tractors

T/3 Fergtrac safety frame for Ferguson TEA-20 Tractors

T/4 Safe 'T' safety frame for Ford 4000 and Ford 5000 Tractors

T/5 Fergtrac safety frame for Ferguson 35 Tractors

T/6 Fergtrac 35 safety frame for Massey Ferguson 35 and 135 Tractors

T/7 Safe 'T' safety frame for Ford 2000 and 3000 Tractors

T/8 Draincoil 2 inch plastic drain piping

T/9 Cromac 2 inch plastic drain piping

T/10 Polydrain $2\frac{1}{4}$ inch plastic drain piping

T/11 Cromac 3 inch plastic drain piping

Research Publications

R/1 The Structural Testing of Tractor Safety Frames ($3 each)

R/2 Water Resources Symposium 40th ANZAAS Congress Proceedings - Part 1 (50 cents each)

R/3 Water Resources Symposium 40th ANZAAS Congress Proceedings - Part 2 (50 cents each)

R/4 Hydrologic Characteristics of Catchments and Lag Time in Natural Catchments (50 cents each)

Project Reports (30 cents each)

P/1 The effect of fire on standard 8 s.w.g. and high tensile $12\frac{1}{2}$ s.w.g. plain fencing wire

P/2 The Hydraulic Performance of Trough Valves

Project Reports (contd)

P/3 Procedures for testing trench laid plastic drain pipes up to 4 inches in diameter.

Annual Reports (free on request)

1965/66

1966/67